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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

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Developement of USTES Aptitude Test Battery

for

Engineer

(water trans.) 197.130

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Technical Report on Development of USTES Aptitude Test Battery

For . . . . .

Engineer (water trans.) 197.130

S-446

(Developed in Cooperation with the
Maryland State Employment Service)

Manpower Administration
U. S. Department of Labor

November 1969

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB #2767

DEVELOPMENT OF USTES APTITUDE TEST BATTERY

for

Engineer (water trans.) 197.130-014

S-446

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Engineer (water trans.) 197.130-014. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
G - General Learning Ability	95
Q - Clerical Perception	100
F - Finger Dexterity	85

RESEARCH SUMMARY

Sample:

64 male students at the Calhoun MEBA Training School in Baltimore, Maryland.

All members of the sample were non-minority group individuals.

Criterion:

A multiple hurdle consisting of average grade-point averages and ratings on performance at sea.

Design:

Concurrent (all students tested after completion of six months of academic training and one year at sea).

Minimum aptitude requirements were determined on the basis of a course analysis and statistical analyses of aptitude mean scores, standard deviations, correlations with the criteria, and selective efficiencies.

Concurrent Validity:

Phi Coefficient = .35 ($P/2 < .005$)

Effectiveness of Norms:

Only 73% of the nontest-selected students in the sample used for this study were good students; if the students had been test-selected with the above norms, 83% would have been good students. 27% of the nontest-selected students used for this study were poor students; if the students had been test-selected with the above norms, only 17% would have been poor students. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Students	73%	83%
Poor Students	27%	17%

SAMPLE DESCRIPTION

Size: N = 64

Educational Status:

Students who had completed 18 months of a two year Marine Engineer curriculum.

Educational Institution:

Students were enrolled in the Marine Engineers Benefit Association Apprenticeship program at Calhoun Training School, Baltimore, Maryland.

Apprenticeship Program Selection Requirements:

Education: High school graduation.

Age: 17 - 29

Previous Experience: None

Tests: None used.

Other: The final decision on acceptance is made by the MMBA selection committee.

Principal Activities:

The job duties of the occupation for which the students were being trained are shown in the Fact Sheet in the appendix.

Minimum Experience:

All students in the sample had been enrolled in the curriculum for 18 months.

TABLE 2

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criteria (total grade-point average) r and (sea ratings) r_1 for Age and Education.

	Mean	SD	Range	r	r_1
Age (years)	21.6	1.7	19-27	.074	-.094
Education (years)	14.4	.7	14-16	.095	.213

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002, were administered during the period of August 1968 to October 1968.

CRITERION

The criterion measures obtained were (1) grade point average (GPA) for first six months of classroom training, (2) ratings of performance during one year at sea, (3) grade point average for last six months of classroom training and (4) score obtained on Coast Guard certification examination. The final date of criterion collection was April 1969. A fifth criterion measure was derived by averaging the two sets of grade-point averages. The correlations between each of these criteria are shown below:

	Sea Perf.	2nd GPA	Cert. Exam.	Average GPA
1st GPA	.193	.494	.465	.840
Sea Ratings	—	.361	.146	.267
2nd GPA	—	—	.321	.842
Certification exam.	—	—	—	.435

A multiple-hurdle criterion consisting of average GPA and sea ratings was selected as the final criterion. The form used to record the academic and sea performance record of all students is shown in the appendix.

Criterion Distribution:	Average GPA	Sea Performance
Actual Range:	129-141	116-366
Mean:	235.6	218.7
Standard Deviation:	47.9	58.4

Criterion Dichotomy: The criterion was dichotomized into high and low groups by placing 27% of the sample in the low group to correspond with the percentage of students considered unsatisfactory or marginal. Students in the high criterion group were designated as "good students: and those in the low group as "poor students". The criterion critical score of 191 on the GPA criterion fails 17% of the students. The criterion critical score of 150 on the sea performance criterion fails 11% of the students.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were considered for tryout in the norms on the basis of a qualitative analysis of the job and course summaries and a statistical analysis of test and criterion data. Tables 3, 4, and 5 show the results of the qualitative and statistical analyses.

TABLE III

Based on the course analysis, the following aptitudes appear to be important for successful completion of the curriculum.

Aptitude	Rationale
G - General Learning Ability	Ability to understand, learn, and apply technical procedures to a variety of situations involving the repair and maintenance of complex-mechanical equipment. Necessary to complete two year apprenticeship training and pass coast guard examination.
N - Numerical Aptitude	Ability to perform mathematical computations while attending apprenticeship school; ability to apply mathematical theory and computations to practical situations such as determining pump G.P.M., electric loads, oil and water consumption, etc.

S - Spatial Aptitude — Studies drawings and specifications; ability to repair mechanical equipment in accordance with detailed equipment, drawings and/or electrical schematics.

K - Motor Coordination — Ability to respond quickly and accurately when emergency repairs are being made to ship equipment.

TABLE IV

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criteria of Average GPA (r) and sea performance (r_1) for the Aptitudes for the GATB

Aptitude	Mean	SD	Range	r	r_1
G - General Learning Ability	113.0	11.9	89-138	.581**	-.045
V - Verbal Aptitude	104.4	11.5	82-137	.466**	.091
N - Numerical Aptitude	114.1	11.2	92-137	.466**	.083
S - Spatial Aptitude	114.5	19.9	81-163	.251*	-.134
P - Form Perception	118.6	14.3	80-151	.411**	.017
Q - Clerical Perception	114.0	12.2	80-142	.362**	.134
K - Motor Coordination	111.2	17.7	49-148	.133	.152
F - Finger Dexterity	102.4	17.1	66-141	.389**	.191
M - Manual Dexterity	124.5	19.9	36-166	-.135	.047

**Significant at the .01 level

TABLE V

Summary of Qualitative and Quantitative Data

Type of Evidence	APTITUDES								
	G	V	N	S	P	Q	K	F	M
Course Analysis Data Important	X		X	X			X		
Irrelevant									
Relatively High Mean				X	X			X	
Relatively Low Standard Dev.	X	X	X			X			
Significant Correlation with Criterion 1	X	X	X	X	X	X		X	
Significant Correlation with Criterion 2									
Aptitudes to be Considered for Trial Norms	G	V	N	S	P	Q		F	

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of various combinations of Aptitudes G, V, N, S, P, Q and F at trial cutting scores, were able to differentiate between the 73% of the sample considered good students and the 27% of the sample considered poor students. Trial cutting scores at five-point intervals approximately one standard deviation below the mean are tried because this will eliminate about 1/3 of the sample with three-aptitude norms. For two-aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about 1/3 of the sample; for four-aptitude trial norms, cutting scores of slightly less than one standard deviation below the mean will eliminate about 1/3 of the sample. The Phi Coefficient was used as a basis for comparing trial norms. The optimum diffentiation for the occupation of Engineer (water trans.) 197.130-014 was provided by norms of G-95, Q-100 and F-85. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .35 (statistically significant at the .005 level).

TABLE VI

Concurrent Validity of Test Norms, G-95, Q-100 and F-85

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Students	7	40	47
Poor Students	9	8	17
Total	16	48	64

Phi Coefficient (ϕ) = .35 Chi Square (X^2_y) = 7.7

Significance Level = P/2 $<$ .005

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study did not meet the requirements for incorporating the occupation studied into any of the 36 OAPs included in Section II of the Manual for the General Aptitude test Battery. The data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.

APPENDIX

CALHOUN M.E.B.A. ENGINEERING SCHOOL

ACADEMIC RECORD

Name:

Group Phase I
Phase III

PHASE I

First Quarter

Date:

SUBJECT	GRADE	CLASS HOURS	QUALITY POINT	DAYS ABSENT

ACCUMULATIVE AVERAGE

CLASS STANDING: NUMBER OF STUDENTS IN CLASS:

Second Quarter

Date:

ACCUMULATIVE AVERAGE

CLASS STANDING: NUMBER OF STUDENTS IN CLASS

Third Quarter

Date:

ACCUMULATIVE AVERAGE

CLASS STANDING: NUMBER OF STUDENTS IN CLASS

Fourth Quarter

ate:

ACCUMULATIVE AVERAGE

CLASS STANDING NUMBER OF STUDENTS IN CLASS

PHASE II

COURSE	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Av.
Math & Physics					
Auxiliary Machinery					
Boilers					
Electricity					
Safety & Fire Fighting					
Turbines					

Phase II consists of one year working aboard merchant vessels 40 hours a week. The students complete four quarters of correspondence courses graded by the school. It is estimated that each quarter represents about 65 hours of work. All unacceptable "sea courses" are returned for correction. The Grading System is as follows: V.G. = Very Good; G = Good; F = Fair; and P = Poor.

PHASE III

First Period Date:

SUBJECT	GRADE	CLASS HOURS	QUALITY POINT	DAYS ABSENT

ACCUMULATIVE AVERAGE:

CLASS STANDING NUMBER OF STUDENTS IN CLASS:

Second Period Date:

ACCUMULATIVE AVERAGE:

CLASS STANDING NUMBER OF STUDENTS IN CLASS:

Third Period Date:

The Grading System for Phases I & III is as follows: A = 90 to 100; B = 80 to 89; C = 70 to 79; D = 60 to 69; F = Below 60 (Failure)

The Accumulated Average is computed by multiplying the class hours by the grade (A = 4, B = 3, C = 2, D = 1). adding these results and dividing by the total class hours except in certain non-preparatory subjects which are counted half weight. These subjects are: Machine Shop, Welding, Engineering Drawing, Boat Handling, Safety & Fire Fight., Machinery Repair, Ship's Medicine, and Labor Relations. Classroom instruction periods are of 50 minutes each.

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FACT SHEET

Job Title: Engineer (water trans.) 197.130-014
[also in construction, fishing and petroleum and natural gas production industries]

Job Summary:

Maintains and repairs engineering plant aboard company ships to insure that operation is efficient and conforms to government operating and safety regulations.

Work Performed:

Supervises, coordinates and participates in activities pertaining to the operation and maintenance of propulsion engines, boilers, deck machinery, refrigerators, air conditioners, sanitation systems, electrical systems, and electronic systems, etc.

Inspects engines and other mechanical equipment; repairs or replaces defective parts; starting, regulating and running all such equipment.

Starts engines to propel ship and regulates engines and power transmission to control speed of ship.

Stands engine room watch during specified periods, observing that required water levels are maintained in boilers, condensors, and evaporators, load on generators is within acceptable limits, and oil and grease cups are kept full.

Maintains an engineering log book while on duty by observing and recording a summary of the functioning of the ships plant such as fuel consumption, temperature changes in equipment, malfunction of equipment and any other occurrences which affect the plant.

Maintains an engineering bell book while on duty by recording orders as they are received from the bridge pertaining to changes in speed and direction of the ship; communicates with bridge in reference to speed capabilities of plant.

Effectiveness of Norms:

Only 73% of the nontest-selected students used for this study were good students; if the students had been test-selected with the S-446 norms, 83% would have been good students. Twenty seven percent of the nontest-selected students used for this study were poor students; if the students had been test-selected with the S-446 norms, only 17% would have been poor students.

Applicability of S-446 Norms:

The aptitude test battery is applicable to jobs which include a majority of the job duties described above.

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